



WORLD GREEN ECONOMY
ORGANIZATION

UAE-UK Clean Hydrogen Collaboration

Accelerating the clean hydrogen sector
through bilateral cooperation in policy,
innovation, trade and investment

Summary report



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About this Report

This report is funded by HSBC and delivered in partnership by the World Green Economy Organization (WGEO) and Zest Associates.

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HSBC is a global leader in sustainable finance, with an ambition to provide USD750 billion to USD1 trillion of finance and investment worldwide by 2030 to help clients in the transition to a net zero carbon emissions economy. Achieving net-zero commitments requires substantial changes across high-emission sectors in all markets. The volume of sustainability-aligned finance that is required to decarbonise the 10 sectors that represent 75 per cent of global emissions will have to grow to over \$100–150 trillion cumulatively in the next three decades, and hydrogen will certainly play an important role on this transition.

The World Green Economy Organization (WGEO) is a multi-stakeholder organization aimed to promote the widespread adoption of green economy principles and practices within the context of sustainable development and poverty eradication.

The organization has a primary focus on sustaining economic growth, enhancing social inclusion, improving human welfare and creating employment opportunities while maintaining and nurturing the planet's ecosystems and mitigating the damaging impacts of environmental degradation on human health and welfare.



Zest Associates is a UAE-based sustainability consultancy that uses its global experience and deep sector expertise to inform public policy, support commercial decision-making and grow the clean tech sector. Zest creates sustainability solutions for governments, consultancies and private companies that want to thrive in the low carbon economy.

Zest develops strategies, policy options and programmes focused on clean tech innovation, green finance, and climate change. We translate aspirations into practical solutions, helping organizations move from ambition to action.

Executive Summary

This study aims to accelerate the clean hydrogen industry in the UAE and UK by identifying priorities and finding opportunities to strengthen cooperation.

The UAE and UK enjoy a strong bilateral relationship and are already working together to advance the clean hydrogen industry. Deeper and broader collaboration across policy, innovation, investment and business could unlock mutual benefits for climate and economic development.

Clean hydrogen is playing a key role in the decarbonisation efforts of the UAE and UK.

Both countries' net zero commitments depend on clean hydrogen to deliver emission reductions, especially in hard-to-abate sectors. The countries' abundant renewable energy resources and natural gas endowments will be used to produce green, blue and potentially turquoise hydrogen, and their nuclear resources may produce pink hydrogen. Waste-to-hydrogen may also play a role. The countries have an opportunity to promulgate low carbon hydrogen standards internationally, moving away from colour-coding and towards the carbon content certifications required to guarantee hydrogen's low carbon credentials. Accounting for the embodied carbon of hydrogen is essential for it to support decarbonisation.

Hydrogen also supports the economic development agendas of the UAE and UK.

Hydrogen offers pathways for greater energy independence in the UK, economic diversification in the UAE, and job creation in both countries. By 2050, hydrogen is estimated to deliver up to AED 32 billion (\$8.7 billion) annually to Dubai's economy alone, and £13 billion (\$15.5 billion) Gross Value Added (GVA) to the UK, as well as over 100,000 new jobs in each country under high-adoption scenarios. These opportunities are driving multibillion-dollar investments, individually, and jointly



through bilateral agreements and Memoranda of Understanding at government and corporate levels. These could be enlarged to match the scale of hydrogen investment required to achieve net zero.

This study draws its insights from nearly 100 hydrogen experts.

The study involved an extensive literature review of over 150 sources. This informed four expert Roundtables, which brought together 33 leaders from both the UAE and UK from across the policy, innovation, business and investment communities to discuss priorities and identify collaboration opportunities. The Roundtable outcomes were distilled into 39 areas of importance, which were grouped into seven thematic areas and formulated into a survey. The areas include policy approaches, increasing supply, increasing demand, encouraging investment, scaling up, advancing innovation, and developing skills. Over 60 international hydrogen experts responded to a survey on these seven

areas. They scored each of the 39 areas to evaluate their individual importance and ranked them in clustered groups to determine their relative merit. The outcomes are included in this report to substantiate its findings.

There is an opportunity to kick-start the market by stimulating supply and demand.

To overcome the 'chicken and egg' challenge facing hydrogen, governments have an opportunity to facilitate the market by mediating between producers and consumers to reduce risks and mitigate price constraints. Germany's H2Global provides a good model to address the top priority of securing government-backed offtake agreements and to overcome price and coordination challenges. The UAE and UK Governments may also consider building a strategic hydrogen reserve, filled with hydrogen that is purchased at market prices and backed by government, to overcome this challenge. Stimulating demand is considered essential, with survey respondents expressing a strong appetite for policies that focus hydrogen on hard-to-abate sectors, underpinned by a price on carbon.

Coordination across sectors, disciplines, and geographies is crucial to accelerate the market.

The relevance of state-owned enterprises in the UAE's hydrogen landscape offers a special opportunity for directive coordination of supply and demand. The UK's hydrogen strategy and industrial clusters mission is strengthening coordination in the UK and the approach could be emulated in the UAE. Bolstering coordination across the energy, industry, transport, buildings, waste & water, and agricultural sectors would reduce market friction, lead to faster cost reductions, and better position hydrogen as a solution to whole-systems challenges in energy and decarbonisation. Cross-disciplinary coordination is also needed to make effective policy, build infrastructure, accelerate innovation, unlock finance and prepare the workforce. There is an appetite from stakeholders in the UAE and UK to deepen cooperation in these domains.

Hydrogen costs could be reduced through collaborative innovation and commercial-scale demonstrations.

Innovation in the UAE and UK is generally strong and improving, with the UK among the world's most innovative countries and the UAE leading regionally. Where the UK excels at early-stage innovation, the UAE excels at later-stage scale-up. This complementarity could be exploited through testing and demonstrations of new UK technologies at UAE facilities, potentially linked to UAE corporate venturing to accelerate scale-up and unlock shared financial returns. For carbon capture and storage – an enabler of blue hydrogen – the UAE's leading technical capabilities could be further utilised in the UK's industrial clusters.

Learning could be accelerated through a dedicated bilateral hydrogen platform that jointly originates innovation projects.

Pilot projects are a top priority of survey respondents, to demonstrate technical, commercial, and operational viability, reduce risks, and validate assumptions on costs and operating parameters. Establishing a bilateral multidisciplinary hydrogen



platform that hosts regular exchanges of people and their viewpoints could seed broader “learning by interacting” and strengthen both countries’ positions by accelerating cost reductions.

There is an opportunity to enlarge investment partnerships, including for enabling infrastructure.

With forecast investment in hydrogen at just 40% of global need, the UAE and UK need to improve the bankability of hydrogen projects to mobilise investment. UAE entities like Masdar, the Dubai Green Fund, or the Emirates Development Bank and the UK’s Infrastructure Bank could act as Green Investment Banks to reduce risks, build technical capability and crowd in private sector finance for this relatively new market. To enable the market, there is an opportunity to enhance UAE-UK cross-border investment into new and refurbished pipelines, storage facilities, electricity transmission and port infrastructure.

The UAE and UK would benefit from joint skills development.

Preparing a skilled workforce first requires identifying skills needs and gaps. Supporting technical and vocational education and training, and retraining workers from the oil and gas workforce is also needed, ultimately leading to cross-border skills standards to ensure safety and facilitate construction. Training and academic cooperation is essential. There is enthusiasm for academic and business partnerships to advance joint training in the field.

As hydrogen’s prominence continues to grow, deeper collaboration across policy, investment, innovation and business will strengthen both countries’ positions domestically and internationally.

Both countries acknowledge clean hydrogen as pivotal to their decarbonisation and development agendas, and they are already capitalising on joint action. There remains opportunity to deepen government cooperation, form dedicated sharing platforms, accelerate joint innovation, and unlock bilateral investments. The global race for leadership in clean hydrogen has yet to be won. By working together, the UAE and UK can harness hydrogen’s enormous economic potential and lead the global low carbon transition.





The Role of Hydrogen in the Green Transition

1.1 Section summary

Overview of findings in this section



The urgency of climate change and renewed importance of energy security is driving the development of the clean hydrogen industry.



To ensure decarbonisation, hydrogen must move from being colour coded (i.e., green, blue, pink, grey) to measuring its carbon footprint using internationally agreed criteria.



Hydrogen is forecast to contribute \$15.5 billion of GVA to the UK economy and \$8.7 billion by Dubai alone, whilst generating over 100,000 jobs in each country by 2050.



Bilateral agreements are laying the foundation for global market growth, and the UAE and UK have signed nearly two dozen bilateral agreements with international partners at a government and industry level.



Further international collaboration is critical for investment and innovation.

Opportunities that the UAE and UK may wish to explore



The UAE and UK have an opportunity to shape a shared low carbon hydrogen standard to guarantee clean hydrogen genuinely contributes to decarbonisation.



Both countries' pursuit of hydrogen made from both gas, renewables and nuclear opens opportunities for collaborative innovation, investment and skills sharing.



The UAE and UK can build on their already strong bilateral relationship to unlock the finance and project pipeline required to reach net zero targets.



The UAE and UK arguably have the most advanced bilateral hydrogen relationship, including:

- The 2021 UAE-UK Partnership for the Future to collaborate to tackle climate change and expand the exchange of knowledge, skills and ideas.
- The £10 billion (\$12 billion) investment agreement to expand the UAE-UK Sovereign Investment Partnership focused on energy transition, infrastructure and technology including hydrogen.
- A Memorandum of Cooperation on Industrial and Advanced Technologies Co-operation, with hydrogen as a priority area.
- At a corporate level, co-investment and co-development of low carbon hydrogen hubs announced through trilateral collaboration between the UAE's Abu Dhabi National Oil Company (ADNOC), Masdar and the UK's BP.



The two countries' complementarities are already acknowledged and there exists mutual value in further deepening their special hydrogen relationship.

Findings from analysis



Figure 1 shows that there is relatively little overlap in the UAE and UK's choice of bilateral partners, illustrating the two countries' different objectives and geographies when it comes to international hydrogen relations.



The UAE intends to be a major global exporter, while the UK will likely be a modest importer with significant domestic production capacity, though Scotland may export.



The UAE is actively seeking to establish itself as a first-choice trade partner, while the UK seeks to build on its early lead in innovation and technology development.

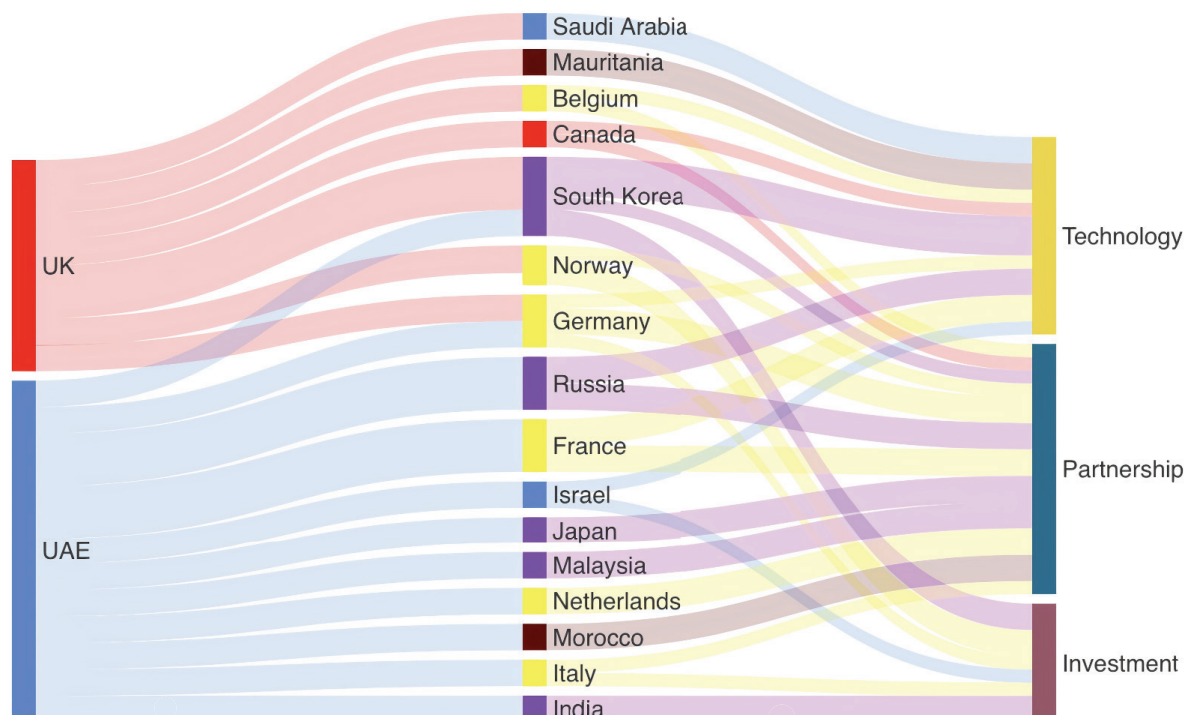


These findings suggest that the UAE and UK have complementary, rather than duplicative, capabilities and goals.



Amongst all the bilateral relationships studied, the strongest links remain between the UAE and the UK themselves.

Figure 1 : Hydrogen MOUs signed between the UAE, UK and other countries



Source: Author's analysis



Kick-starting the market

2.1 Section Summary

Overview of priorities identified in this section



Government intervention is needed to kick-start the market and overcome the misalignment between producers and consumers.



Policies that direct hydrogen towards hard-to-abate sectors are critical.



Directive policies are most effective when underpinned by price signals and a supportive macroeconomic environment.



Stimulating demand is considered more important than supporting supply.



Offtake agreements are critical to reduce risks, improve bankability and unlock finance.



Coordination across sectors, disciplines and geographies helps to establish domestic markets, balance supply and demand, align stakeholders' interests and overcome market friction.

Opportunities that the UAE and UK may wish to explore



Consider introducing carbon trading mechanisms or carbon pricing in the UAE, or raising the carbon price in the UK, and reduce fossil fuel subsidies to help level the playing field for hydrogen and stimulate demand



Outline specific policy details for how hydrogen is expected to contribute to both countries' national net zero commitments to build confidence in the market.



Encourage corporate net zero targets to orient the industry towards specific offtakers.



Focus government support and public investment on hard-to-abate sectors to maximise hydrogen's commercial competitiveness and its climate impact.



Collaborate on initiatives directed at the industrial and transport sectors, especially shipping and aviation, to create domestic markets that lead to scale-up and cost reductions.



Consider Germany's H2Global as a model to mediate between producers and consumers, secure offtake agreements and manage price constraints.



Create a UAE-UK coordination platform to facilitate the whole supply chain, including technical, commercial, operational and policy stakeholders.

Priorities from expert survey respondents¹

Policy priorities



A combination of directive policies and free-market policies are likely to be most effective at kick-starting the market, though directive policies are strongly prioritised.



Setting the right macro conditions through markets, especially using carbon pricing, lays a foundation of incentives that improve the economic viability of hydrogen.



Directive policies help trigger action when the underlying financial incentives are not strong enough and overcome non-financial barriers.



Stimulating demand is considered significantly more important than stimulating supply, suggesting that the hydrogen market is currently supply-led, with producers taking market risk to secure early mover advantage.



While supporting the supply chain scores relatively highly individually, it is considered significantly less important to encourage the market.



Source: Author's analysis

Priorities to stimulate demand



Carbon pricing is overwhelmingly seen as the top priority to boost hydrogen demand.



National net zero targets are considered more effective than corporate ones, likely because national targets set the framework in which corporations must operate.



Survey respondents' belief in the effectiveness of corporate net zero targets suggests that hydrogen demand can be stimulated even in the absence of national action.



More specific policy around national net zero targets is needed to supporting demand, requiring hydrogen's role in achieving net zero targets to be further specified.



While the two directive policies – stimulating local demand and using public procurement – are considered important individually, they rank poorly compared to the market mechanisms. Considering the perceived importance of directive policies, this may mean that other kinds of directive policies would be preferred, like a focus on hard-to-abate sectors.



Source: Author's analysis

Priorities to support supply



Securing government-backed offtake agreements are overwhelmingly considered essential to supporting supply, while credit guarantees are favoured to reduce risk.



Contracts for Difference are preferred among the three price support mechanisms.



Despite hesitancy among survey respondents, the German H2Global model secures offtake, mediates between supply and demand and manages price. The model effectively addresses survey respondents' other priorities.



Boosting profit margins of blue hydrogen by injecting CO2 underground for Enhanced Oil Recovery is resolutely disfavoured.



Source: Author's analysis



Pathways to scale-up and reduce cost

3.1. Section summary

Overview of priorities identified in this section



Innovation and scale are needed to drive down hydrogen's costs.



There remains significant scope for innovation in technologies that produce and use hydrogen.



Pilot projects are considered most important to prove hydrogen's technical and commercial viability.



Innovation in electrolyzers is preferred over technologies that use gas for hydrogen.



The UK excels at earlier-stage innovation, while the UAE excels at later-stage scale-up, though the UK is extending its strength out to larger-scale demonstrations.



Different types of learning contribute to cost reductions, and 'learning by interacting' is especially important for the hydrogen industry.

Opportunities that the UAE and UK may wish to explore



Capitalise on the UAE and UK's complementary positions regarding early- and late-stage innovations and demonstrations to run pilot projects.



Run pilot projects that capitalise on the UAE and UK's complementary positions regarding early- and late-stage innovations and demonstrations.



Establish joint research and testing programmes or accelerator initiatives to test technologies in representative environments.



Form a joint hydrogen platform for exchange between disciplines and sectors to maximise 'learning by interacting' and accelerate innovation and cost reductions.



Leverage joint programmes for technology exchange and corporate venturing activity to accelerate scale-up and unlock shared financial returns.



Capitalise on existing strengths in CCS to enable genuinely low carbon blue hydrogen.



Consider the UK's industrial clusters approach in the UAE to facilitate coordination and reduce costs.

Priorities from expert survey respondents²

Innovation priorities



There is very strong agreement that pilots are extremely important to enable the industry to grow.



Early-stage research is still considered very important, which shows the need for innovation to deliver cost reductions across the whole technology development chain.



The perceived need for accelerators and to a lesser extent national test centres is relatively strong individually, though of significantly lesser priority comparatively.



There is significantly more enthusiasm to focus on reducing the costs of green hydrogen through electrolyser innovations rather than on more novel and less mature approaches like turquoise hydrogen.



Source: Author's analysis

Findings from analysis

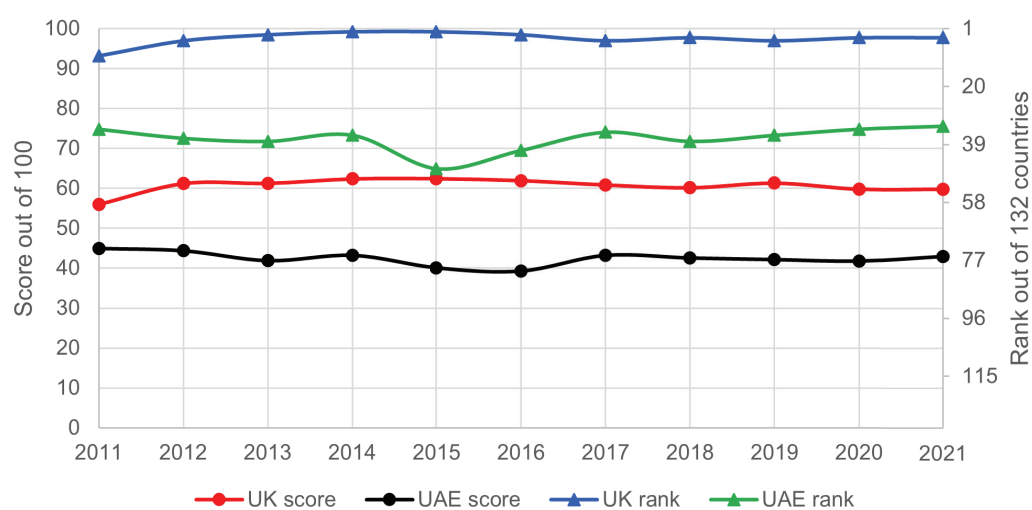


Innovation in the UAE and UK is generally strong and improving, with the UK among the world's most innovative countries and the UAE leading regionally. Innovation performance scores and ranks shown in Figure 2.



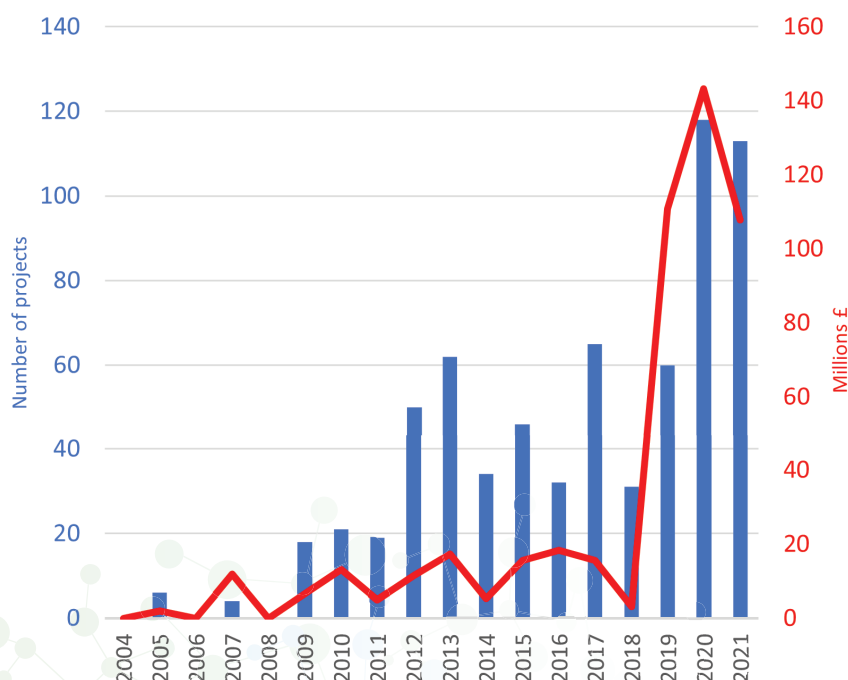
Analysis of the UK's public funding landscape for hydrogen shows a significant shift in the value, volume and type of funding that has been dedicated to hydrogen. Figure 3 shows that while the number of hydrogen projects being funded by Innovate UK has roughly doubled over the past three years, the value of projects funded has increased more than five-fold. This signals both a serious commitment to hydrogen innovation and a move towards later-stage innovations and demonstrations, which are more expensive than early-stage research.

Figure 2: UAE and UK Global Innovation Index ranks and scores, 2011 - 2021

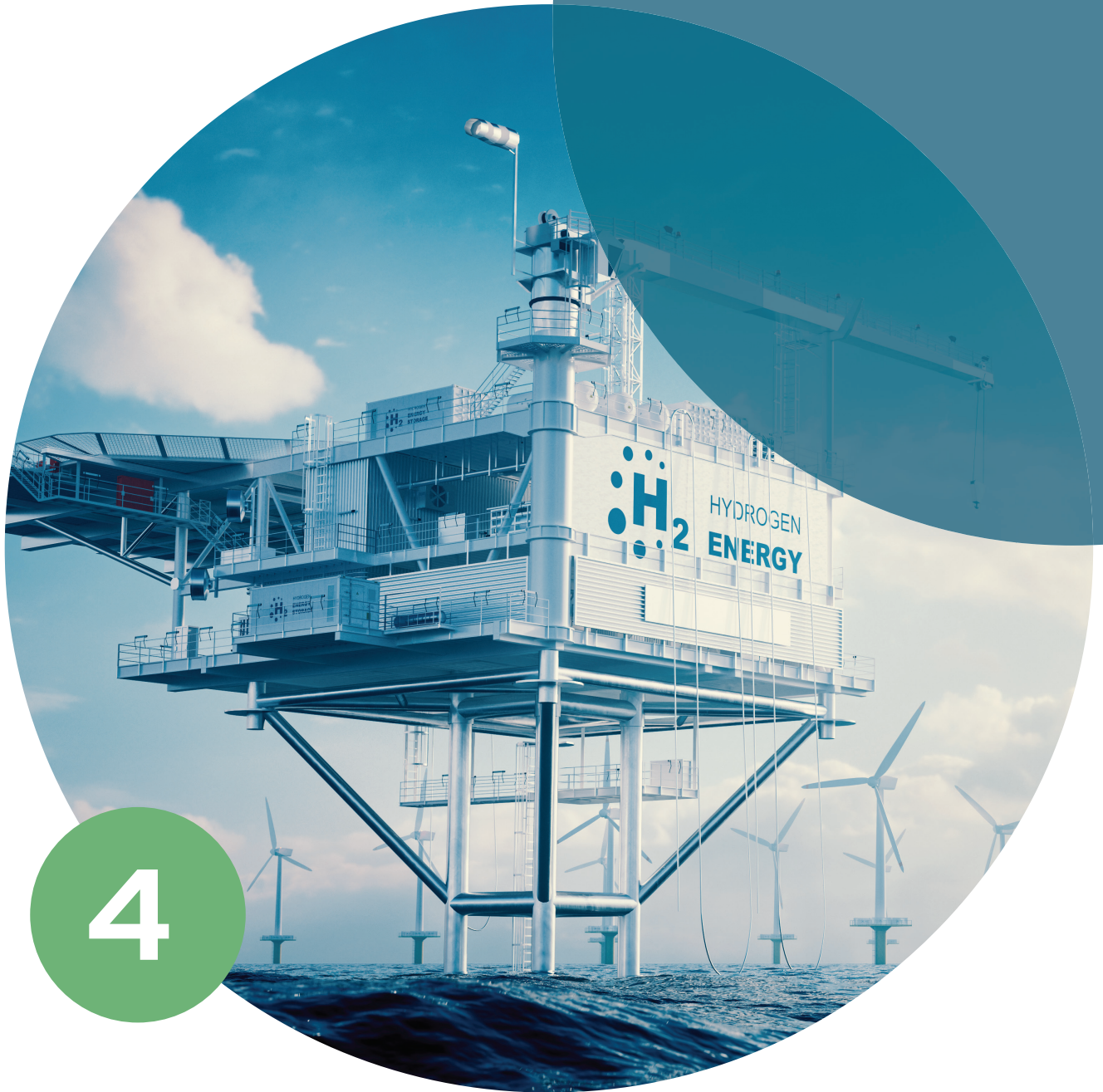


Source: Adapted from WIPO³

Figure 3: Innovate UK hydrogen projects and funding, 2004 - 2021



Source: Innovate UK⁴ and author's analysis



4

Ways to enable the market

4.1 Section Summary

Overview of priorities identified in this section



To accelerate the hydrogen market, investment must be facilitated, infrastructure built and skills developed.



Just 40% of the investment in hydrogen that is required to reach net zero is forecast by 2030, leaving significant scope for bigger UAE and UK investment activity.



Improving the bankability of hydrogen projects is a top priority to unlock finance.



Green Investment Banks are considered helpful to mitigate risk perceptions and mobilise private sector finance.



New and refurbished pipelines, storage facilities, ports and electricity transmission infrastructure are considered critical.



Identifying skills gaps is a top priority to prepare the future hydrogen workforce, with a special focus on technical and vocational education and training.

Opportunities that the UAE and UK may wish to explore



Consider leveraging existing entities like the UAE's Masdar or the UK's Infrastructure Bank to provide technical assistance and innovative finance that attracts private investors to hydrogen projects and enabling infrastructure.



Establish a joint investment vehicle, for example, a \$10 billion UAE-UK hydrogen investment fund, to mobilise finance into the sector.



Apply the UK industrial clusters approach, or 'hydrogen valley' concept, in the UAE, where complementary industries are collocated to capitalise on shared infrastructure and close proximity of hydrogen inputs, outputs, supply, demand and transport.



Develop case studies that demonstrate the technical, financial and operational viability of hydrogen projects to reduce risk perceptions and unlock finance.



Build on the UAE-UK Sovereign Investment Partnership and create new investment agreements to increase the volume of cross-border investment into hydrogen projects and infrastructure.



Bring together UAE and UK stakeholders from industry, academia and training academies to identify future skills gaps and develop appropriate training programmes.



Consider how oil and gas workers in both countries can be retrained to enable a just transition and capitalise on the workforce's existing skillset.



Pioneer the development of international skills standards and training activities to facilitate cross-border projects and to become global centres of excellence in hydrogen skills.



Connect UAE and UK training centres to promulgate shared training courses, potentially using UK satellite campuses in the UAE.

Priorities from expert survey respondents⁵

Priorities to drive investment



Bankable projects must be prepared to raise the volume of investment required to meet net zero, and creating bankable structures is the overwhelming priority to drive investment.



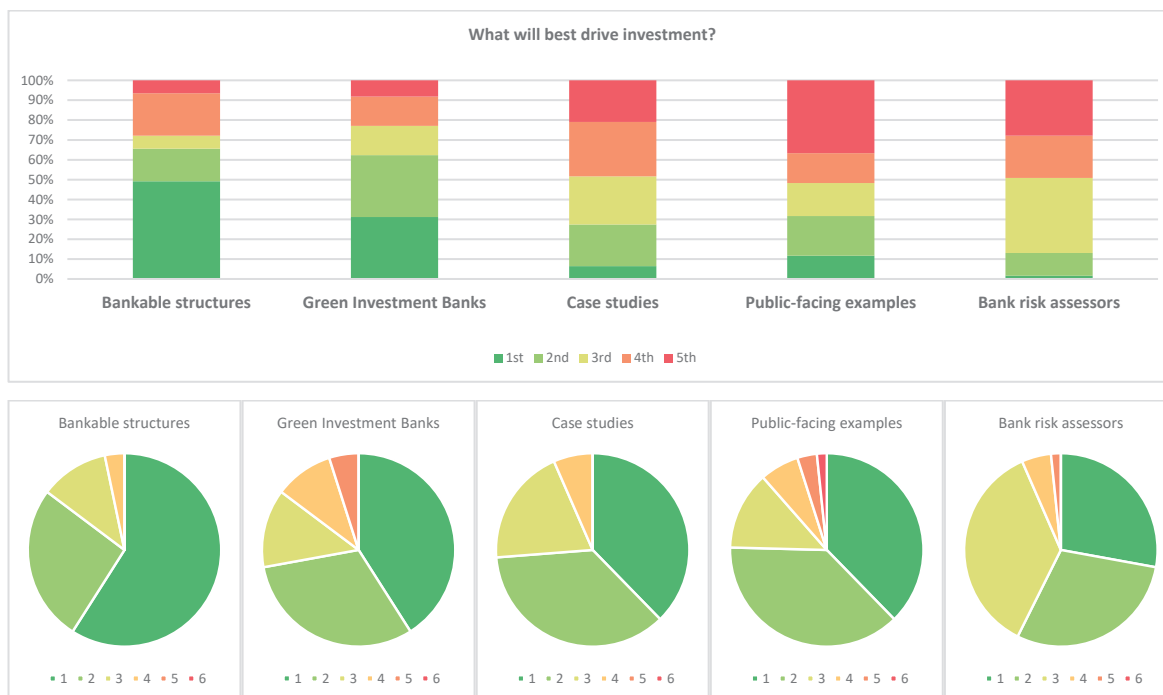
Using a Green Investment Bank to overcome risks, provide technical assistance, and mobilise private sector investment into hydrogen is also a very popular option, with proven track record of 'crowding in' private finance in other industries like offshore wind.



Risks can also be managed, and public confidence built, through case studies and public facing examples that show hydrogen's viability. While these options are score relatively well individually, there is little consensus on their overall priority.



Upskilling the technical capability of bank risk assessors is seen as individually important, but is not considered a priority.



Source: Author's analysis

Priorities to scale-up



Infrastructure enables the hydrogen market to scale-up, but there is no broad consensus on what kind of infrastructure ought to be prioritised.



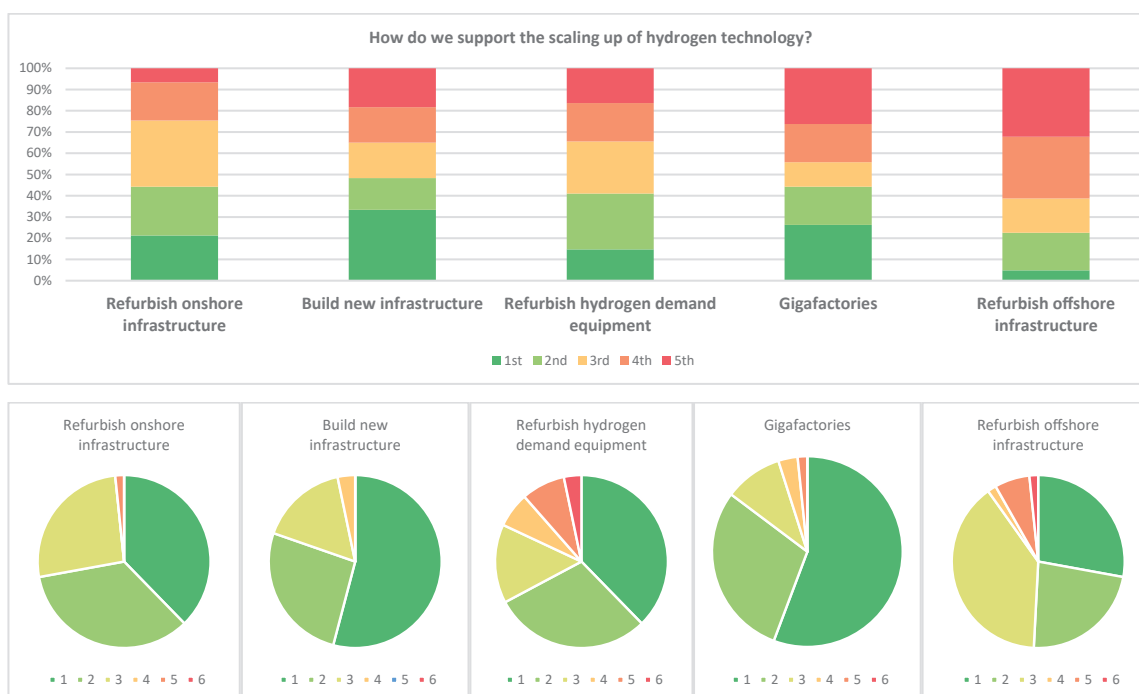
Refurbishing onshore infrastructure ranks highest but both 'building new infrastructure' and 'building gigafactories' outstrip it positively (the combined first and second choice) and negatively (the combined fourth and fifth choice).



Refurbishing hydrogen demand equipment enables demand to be supported, but it also attracts a wide spread of positive and negative ranks.



Refurbishing offshore infrastructure, such as oil and gas platforms, is least preferred, likely because there is relatively little relevant offshore infrastructure compared to the amount of refurbishable onshore pipelines, storage facilities and fuelling stations.



Priorities for skills development

Source: Author's analysis



Building the skills and capabilities of the hydrogen economy workforce is essential, and identifying skills gaps is the clear top priority. This shows the industry's nascence and uncertainty around what skills are needed today and in the future hydrogen economy.



While skills gaps are not yet clear, priority is nevertheless given to technical and vocational education and training (TVET) over higher education, potentially showing a stronger perceived need for hydrogen project implementers compared to researchers.



Retraining oil and gas sector workers scores highest and ranks third, potentially showing crosscutting skillsets and also hydrogen's potential role in the just transition.



International collaborations on skills, including developing international skills standards and cross-border training programmes, are not considered strong priorities.



Source: Author's analysis

References

¹ Over 60 international hydrogen leaders were surveyed. They scored individual options from 1 (extremely important) to 6 (not at all important), and ranked clustered groups from top priority (1st) to lowest priority (5th or 6th). Scores are shown as pie charts, and ranks are shown as bar charts.

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³ World Intellectual Property Organization. (2022). Global Innovation Index. <https://www.wipo.int/publications/en/series/index.jsp?id=129>

⁴ Innovate UK. (2022). Innovate UK funded projects since 2004. <https://www.ukri.org/publications/innovate-uk-funded-projects-since-2004/>

⁵ Over 60 international hydrogen leaders were surveyed. They scored individual options from 1 (extremely important) to 6 (not at all important), and ranked clustered groups from top priority (1st) to lowest priority (5th or 6th). Scores are shown as pie charts, and ranks are shown as bar charts.

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